

MILITARY OPERATIONS RESEARCH SOCIETY



*Chemical-Biological Weapons of Mass Destruction:
Understanding the Problem*
30 January – 1 February 2001

Chairs

Dr. Bruce Bowman
LTC Jerry Glasow

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Abstract

The Workshop successfully accomplished its goal of developing an understanding of Chemical-Biological (CB) WMD defense analysis problems confronting the United States at home and abroad. The participants, numbering 147 and representing a wide array of defense, federal and commercial organizations, assessed the military operations research community's capabilities to support military and civil CB WMD defense, crisis response and consequence management efforts.

Principal findings include recognition that significant uncertainties constrain efforts to confidently assess chemical and biological warfare effects, available analytical models are inconsistent, and the community of expert analysts is overly fragmented with inadequate training and resources. The associated recommendations focus upon efforts to reduce technical and operational data gaps through experimentation, exercises and tests over the next five to ten years; to implement operational risk management and mitigation procedures that are flexible and effective over a dynamic range of threats; to establish standards and procedures for validating and accrediting analytical models and the associated data; and to foster professional communities of chemical-biological warfare analysts by establishing rewarding career paths in all military services and federal agencies, integrating expert groups, and providing certified training.

Dr. Anna Johnson-Winegar, the Deputy Assistant to the Secretary of Defense for Chemical-Biological Defense, appointed by the DEPSECDEF and the USD(AT&L) as responsible for all DoD Chemical and Biological Modeling and Simulation, accepted the workshop findings and is standing up a CB M&S Oversight Group to address them.

Executive Summary

MORS rang in the new millennium by successfully sponsoring a workshop focused upon Chemical-Biological Weapons of Mass Destruction (CB WMD). Championed jointly by the Office of the Deputy Assistant to the Secretary of Defense for Chemical-Biological Defense and by the Defense Threat Reduction Agency, the workshop convened 30 January – 1 February 2001, at the Tyson's Corner conference facilities of Booz-Allen & Hamilton, McLean, Virginia.

The Workshop successfully accomplished its goal of developing a comprehensive and improved understanding of Chemical-Biological WMD defense analysis problems confronting the United States at home and abroad. The participants, numbering 147 and representing a wide array of defense, federal and commercial organizations, assessed the military operations research community's capabilities to support military and civil CB WMD defense, crisis response and consequence management efforts.

Principal findings include a recognition that significant uncertainties constrain efforts to confidently assess chemical and biological warfare effects, available analytical models are inconsistent, and the community of expert analysts is overly fragmented with inadequate training and resources. The associated recommendations focus upon efforts to reduce technical and operational data gaps through experimentation, exercises, and tests over the next five to ten years; to implement operational risk management and mitigation procedures that are flexible and effective over a dynamic range of threats; to establish standards and procedures for validating and accrediting analytical models and the associated data; and to foster professional communities of chemical-biological warfare analysts by establishing rewarding career paths in all military services and federal agencies, integrating expert groups, and providing certified training.

Dr. Anna Johnson-Winegar, the Deputy Assistant to the Secretary of Defense for Chemical-Biological Defense, presented the keynote address that highlighted capabilities, essential organizations, and principal analysis issues of the chemical-biological defense program. She was followed by a panel of speakers that included Dr. Lamb, Acting Deputy Assistant Secretary of Defense for Requirements, Plans, and Counterproliferation Policy; MG Doesburg, Commanding General, Soldier, Biological, and Chemical Command; Dr. Resnick, Director, Chemical-Biological Directorate, DTRA; COL Klewin, Chief of Staff, US Army Chemical School; and Dr. Bennett, RAND. The panel provided valuable insights into analysis needs for the conduct of military operations across the full spectrum of operations from peacekeeping to major regional war.

Mr. Donald Hamilton, Deputy Director of the Oklahoma City Memorial Institute for the Prevention of Terrorism, opened the afternoon with an expert presentation on counterterrorism and was followed by a panel of speakers addressing analysis issues related to military support to civil authorities. The afternoon panel included Mr. Antush, Federal Emergency Management Agency (FEMA); BG Barbisch, Commanding General, 3rd MEDCOM; COL Steinmetz, Director, Consequence Management Program

Integration Office; MAJ Russell, Directorate of Military Support; and Mr. Aucott, Rhode Island Emergency Management Agency.

The first day of plenary presentations and panel discussions concluded with presentations from Mr. Grenier, Joint Service Materiel Group, and Mr. Lueck, Joint Service Integration Group, on CB modeling and simulation commodity area management and modeling plan, respectively.

Many of the plenary session presentations may be found at the MORS website via the hyperlink http://www.mors.org/cb_wmd/presentations/Presentations.htm.

The ensuing second and third days were filled with valuable working group presentations and discussions that amplified key issues addressed by the senior leaders during the plenary session. The working groups chaired by COL Richard Hanley, AFSAA; Mr. Greg Andreozzi, CAA; Dr. Charles Ward, NGIC; Mr. Mike Kierzewski, Optimetrics; Ms. Christine Fossett, FS, GAO; and Dr. Bruce Bennett, RAND, provided a better understanding of military operations research capabilities to support military and civil authorities; CB WMD analytical tools and methodologies; and CB WMD data sources.

The Workshop Co-Chairs will present the Workshop findings at the 2001 MORS Symposium and to MORS Sponsors. Thank you to all participants and supporters of this highly successful and informative Workshop.

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CB WMD: Understanding the Analysis Problem



OPERATIONS ANALYSIS WORKING GROUP *Low Spectrum Analysis Subgroup*

Chairs

- Col Rich Hanley, AFSAA
- Mr. Greg Andreozzi, CAA

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Due to the expected size of the Operations Analysis Working Group and to maximize participant interaction, we split this working group into two subgroups: the High Spectrum Subgroup and the Low Spectrum Subgroup. Colonel Rich Hanley of the Air Force Studies and Analysis Agency (AFSAA) chaired the High Spectrum Subgroup and Mr. Greg Andreozzi of the Center For Army Analysis (CAA) chaired the Low Spectrum Subgroup.

Together, the two subgroups were designed to cover the full spectrum of operational contingencies. The primary focus of the High Spectrum Subgroup was at the Major Theater War (MTW) level while the Low Spectrum Subgroup's primary focus was the Small Scale Contingency (SSC) level, to include CONUS Civil Support missions. The intention was for each subgroup to leverage and integrate Chemical and Biological (CB) Weapons of Mass Destruction (WMD) defense analysis issues, solutions and lessons learned from the full spectrum of operational contingencies.

This briefing details the insights developed by the Low Spectrum Subgroup. Analytic issues focusing on high spectrum conflict are covered in a separate brief.

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Low Spectrum Conflict Subgroup



Dr. Allen	IDA/SED	MAJ McCready	AFSAA
LtCol Ahmed	MD ANG	Mr. McCready	USCG R&D Center
Mr. Andreozzi	CAA	Ms. Milchling	SBCCOM
LT Aucott	First Coast Guard Dist.	Mr. Norman	BAH
LTC Beam	MDW	Ms. Razulis	SBCCOM
Mr. Cherry	Logicon	Mr. Ryan	ITT
LTC Cummings	CoMPIO	Mr. Sands	MITRE
Mr. Dickson	MANSSEN	Mr. Sergio	BAH
Mr. Dunaway	Noesis, Inc.	Mr. Slavinski	CMI-Services
Mr. Hall	CAA	Mr. Tehee	MSIAC
LTC Hill	USA/NC	Mr. Thornton	HQ AFCESA/CEXR
Ms. Harlow	JHU/APL	Mr Gene Visco, FS	Synthesis group
Ms. Hoeber	AMH Consulting	Mr. Wallis	IDA
MAJ Laughridge	MDW DCSOPS	Mr. Zielinski	DTRA
LT Lechthaler	USCG ACTNY		

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The Low Spectrum Conflict Subgroup was comprised of a good blend of government and industry personnel involved in chemical and biological WMD defense issues. Most of the group worked in the civil support area, and thus much of our discussion was focused on CONUS civil support rather than OCONUS SSC and MTWs, although overlaps were recognized. Many of the participants worked in program development and analysis areas, while some are potential users or customers of these programs and analysis.

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Low Spectrum Conflict Subgroup Agenda



31 January 2001

0800 – 0850	* Impact of CB Weapons on Joint Operations in 2010	Ms. Hoeber, AMH Consulting
0900 – 0950	Military Support for Civil Response to Attacks using Weapons of Mass Destruction	LTC Cummings, CoMPIO
1000 – 1050	CMI-Services	Mr. Slavinski, Battelle
1100 – 1150	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA
1200 – 1300	Working Lunch	
1300 – 1350	* WMD Issues for the QDR	Mr. Schultz, IDA
1400 – 1450	Improved Response Program	Ms. Milchling, SBCCOM
1500 – 1700	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA

1 February 2001

0800– 0950	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA
1000 - 1050	* CB Web Site Demo	Mr. Zimmers, DTRA
1100 – 1150	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA

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The two days of working group sessions were evenly divided between a series of excellent information briefings and subgroup discussions. Three briefings were provided to the combined Operations Analysis Working Group due to their applicability to both High Spectrum and Low Spectrum Conflict. Ms. Amie Hoeber of AMH Consulting provided a summary of the October 1997 study on the “Impact of CB Weapons on Joint Operations in 2010,” Mr. Doug Schultz of IDA presented an IDA study he led which looked at how CB should be quantified in the upcoming Quadrennial Defense Review (QDR); and Mr. Walter Zimmers of the Defense Threat Reduction Agency (DTRA) introduced participants to DTRA’s classified and unclassified web sites supporting CB data requirements.

Three additional briefings addressing civil support programs and issues were provided to the Low Spectrum Conflict Subgroup separately. LTC Edna Cummings of the Consequence Management Program Integration Office (CoMPIO) briefed on “Military Support for Civil Response to Attacks using Weapons of Mass Destruction,” Mr. Art Slavinski of Batelle provided a briefing on the “Consequence Management Interoperability (CMI) Services” effort the Marine Corps is currently working; and Ms. Suzanne Milchling of SBCCOM provided an overview of the “Improved Response Program” which included recommendations for future analysis efforts.

Remaining working group time was spent in subgroup working sessions, addressing key analysis issues outlined in the workshop terms of reference, with insights presented in the following slides.

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Stakeholders



- Drivers (Policy/Policy Makers/Sponsors)
 - DATSD(CBD), ATSD-CS, ASD(SO/LIC),
ASD(RA), military services, federal, state and local
agencies, Presidential Decision Directives (PDDs),
DoD instructions and others
- Participants (Product/System Developers, Analysis)
 - DTRA, SBCCOM, national labs, military analytical
community, industry, academia and others
- Users (Customers)
 - Federal, State and Local agencies, CSEPP localities,
CINCs, Installations, PMs, Military rapid response
organizations (JTF-CS, CSTs, etc.) and others

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Numerous stakeholders exist in CB WMD Defense Analysis with varying roles. The Low Spectrum Subgroup attempted to subdivide the stakeholders into three levels - Drivers (Policy / Policy Makers / Study Sponsors), Participants (Product / System Developers, Analysis) and Users (Customers). Shown is a representation of the stakeholders at the three levels. It should also be pointed out that organizations can appear at more than one level. For example, a Driver can also be a User or Customer of a product that a Participant develops. A common theme among all these stakeholders is the need for clearer definition of roles and closer integration.

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Operational Objectives for CB WMD Analysis



- Supported Functions
 - Prevent CB attack
 - Protect against CB attack
 - Respond to CB attack
 - Restore operations
- Overarching objectives
 - Hazard prediction
 - Casualty estimation
 - System performance
 - Doctrine development
 - Training
 - Simulation based acquisition
 - CONOPS development

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In order to best address the operational objectives for CB WMD analysis, the Low Spectrum Subgroup first felt a need to define the functions that operational objectives must support. The four supported functions identified were prevent (or deter) CB attack, protect against CB attack, respond to CB attack and restore operations.

Seven overarching objectives, each of which support one or more of the functions identified above, are hazard prediction, casualty estimation, system performance, doctrine development, training, simulation based acquisition and concept of operations (CONOPS) development. If necessary, each of these overarching objectives can be broken down into sub-objectives for more detailed analysis.

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OR Characterization of Threats and Effects



- Data Sources
 - Actual data
 - Simulant data vs. actual agent
 - Parametric data
 - Anecdotal data
 - Professional judgement
- Validity an issue with all data sources

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We chose to represent the OR characterization of threats and effects through the identification of data options. The first choice in the characterization is the use of direct or actual data. Because of existing data gaps, we must find alternative means to represent threats and effects. The subsequent options listed (simulant data, parametric data, anecdotal data and professional judgement) may be available. In all cases, data validity is an issue that must be addressed.

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Current Analysis Efforts and Developments in Analysis Tools



- Improved response program (e.g. Modular Emergency Medical System)
- HLA as an IEEE standard
- Incorporation of complex urban terrain into laptop models
- Model validation (e.g. IDA work on transport and dispersion models)
- Use of war gaming to analyze CB defense
- Equipment standardization and test methodology efforts (e.g. IAB and others)

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Provided here are some of the efforts and tools currently being worked to address CB WMD defense analysis. They range from hardware and software improvement and standardization efforts to qualitative analysis efforts. They are just a small sample of the analytical work being done to improve our understanding of critical issues in CB WMD defense.

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Shortfalls in CB WMD Analysis



- Understanding and prioritization of CB threats
- Validation and availability of models, data and scenarios
 - Identifying best data providers
- Acceptance of DoD models by civilian community
- Resource requirements and capabilities studies supporting CONUS CB defense

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In order to effectively prioritize future CB WMD defense analytical efforts, we must first gain a better understanding of CB threats. Analysis can also be better focused if threats can be prioritized. Validating our models, data and scenarios is critical to sharing them within DoD, and when appropriate, with our foreign coalition partners and the US civil community. We need to establish the lineage of our models, data and scenarios. There must be an audit trail for model algorithms and data. The ability to share information within and outside DoD is extremely critical, and we must ensure our potential partners are cognizant of our products and comfortable with their use.

Another area that deserves special attention is developing a clear understanding of resource requirements and capabilities (force structure, equipment, etc) to support CONUS CB defense.

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Proposed Developments in Analysis Tools



- Develop joint service models
- Develop combined agents effects models (chemical and biological)
- Develop deployment and resource model(s) to track resource availability and flow between SSCs, MTWs and CONUS CB incidents
- Develop MOEs to evaluate utility of existing models (e.g. risk assessment, civilian requirements)
- Develop mission degradation algorithm
- Develop tailored terrain data bases (e.g. infrastructure, multidimensional cloud features, demographic data)
- Develop and make available a catalog of available scenarios
- Develop knowledge management system (e.g. SBCCOM, CMI-Services) accessible to stakeholders
- Use data mining tools to capture and assess salient data for specific analysis (e.g. exercises, wargames, CALL, BDA, JULLS)

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A number of proposed development tools have been identified to address the shortfalls addressed in the previous slide. They range from development of algorithms and models to improved data management tools.

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Proposed Analysis Efforts



- Conduct efforts to gain outside acceptance of DoD Models (option for MSCA is use of National Response Team (NRT))
- Conduct exercises, simulations and experiments to validate assumptions, verify capabilities, and identify resource requirements
- Examine availability of CB resources to support CONUS CB incident(s) in conjunction with execution of SSC(s) and MTW(s)
- Continue to examine RC/NG requirements and capabilities in CONUS WMD Response
- Develop a prioritization of threats to facilitate the planning, programming, budgeting process
- Develop interoperability standards and common terms of reference between:
 - Military combat operations and MSCA
 - DoD and civil community (Federal, state and local as required)
 - US and coalition partners
- Develop standard operating procedures for sharing sensitive information with civil community (Federal, state and local as required)

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As with proposed analysis tools, numerous analysis efforts have been identified on the following two slides to address the previously mentioned shortfalls. These efforts focus strongly on qualitative as well as quantitative analysis to gain a better understanding of the CB WMD defense problem. Developing standards is a recurring theme in these proposed efforts.

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Proposed Analysis Efforts (cont.)



- Examine realistic capability of current technology
 - Determine required reliability and specificity (e.g. detectors, PPE)
- Backtrack capability for meteorological detection in urban environment (identify source for criminal investigation and determining infected population)
- Research applicability of non DoD industrial chemical modeling for DoD use (e.g. TICS and TIMS)
- Determine DoD CONOPS for industrial hazards (e.g. personal protective clothing assessments)
- Analyze mass casualties from CW and BW attacks
- Update dose response data for both chemical and biological
- Assess medicine and vaccine deployment throughout the US (military and civilian)
- Analyze human factors (e.g. psychological, physiological, hostile intentions), both military and civilian

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How Well Do We Understand the Problem? - Key Insights -



- Need to improve our understanding of:
 - The behavior of chemical and biological agents (e.g. toxicity, cloud behavior, operational degradation)
 - The physical environment (e.g. urban, suburban, subterranean, hydrology, meteorology)
 - Human factors (e.g. psychological, physiological, hostile intentions)
 - Political realities (Congressionally mandated authority and funding of special units and equipment)
 - Legal realities (Posse Comitatus, Title 10 and Title 32)
 - CB WMD response resource requirements
- Shortfall of CB knowledgeable OR analysts

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There are several areas In CB WMD defense where we must improve our knowledge, ranging from the behavior of chemical and biological agents, to how the physical environment impacts on agent behavior, to the human factors involved. As we examine these issues, we must also be cognizant of and work within existing political and legal realities.

Finally, we can't ignore the need for quality analysts with an understanding of CB. Creative programs must be established to develop and maintain these analysts.

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Recommendations to Improve Our Understanding



- Bound the problem
- Define roles and responsibilities at all levels (strategic, operational and tactical)
- Improve OR and user interface to identify requirements and obtain products
- Prioritize analysis efforts

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Numerous development efforts were proposed by the Low Spectrum Subgroup in previous slides. Determining where to start can be aided by bounding the CB WMD defense analysis problem. Some focus and prioritization must be established. This can be made easier through a clear definition and understanding of roles and responsibilities of stakeholders at all levels. Forums like this workshop serve as great interface vehicles between the operations research and user communities at all levels — policy makers, developers and operators.

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CB WMD: Understanding the Analysis Problem



OPERATIONS ANALYSIS WORKING GROUP

High Spectrum Analysis Subgroup

Chairs

- Col Rich Hanley, AFSAA
- Mr. Greg Andreozzi, CAA

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Due to the expected size of the Operations Analysis Group and to maximize interaction amongst attendees, we split this group into two subgroups: the high spectrum subgroup and the low spectrum subgroup. There was no intention to segregate the civil support community from the military combat community, although in practice that may have been what happened. Colonel Rich Hanley chaired the High Spectrum Subgroup and Mr. Greg Andreozzi chaired the Low Spectrum Subgroup.

This briefing covers modeling, simulation and analysis of Chemical and Biological (CB) weapons, as they pertain to high spectrum conflict. Analytic issues pertaining to low spectrum conflict are covered in a separate brief.

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Approach



- Understand WMD analysis issues:
- Relationship of civil support and combat operations in analysis
- Interactions with decision makers and other CB analysts
- Availability of data — sources, fidelity and level of effort
- Integration of WMD into analysis models and tools
- Past, current and future analyses

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The approach taken by this workshop was to use the expertise and insights from a broad spectrum of people involved in chemical and biological weapons issues; especially those conducting military warfighting analysis at the campaign-level and those providing support to the civil community. Areas of concentration were roughly divided into four main categories: Interactions with decision makers and other CB analysts; availability of data sources; integration of WMD into analysis models and tools; and, insights from analyses.

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High Spectrum Agenda



31 January 2001

0800 - 0805	Introduction	Col Rich Hanley, AFSAA
0805 - 0850	CB Weapons Threat Issues, 2010	Ms. Hoeber, AMH Consulting
0900 - 0950	JWARS WMD development	LTC George Stone, OSD PA&E
1000 - 1150	Discussion/Working Period	Col Rich Hanley, AFSAA
1200 - 1300	Lunch	
1300 - 1350	WMD Issues for the QDR	Mr Doug Schultz, IDA
1400 - 1450	AF/XONP Airbase Study	Mr John Lawrence, SAIC
1500 - 1650	Discussion/Working Period	Col Rich Hanley, AFSAA

1 February 2001

0800 - 0825	Civilian Casualties in an MTW	Ms. Debbie Lott, CAA
0825 - 0850	CB Modeling Uncertainties	Mr Martin Richardson, MEVATEC
0900 - 0950	Discussion/Working Period	Col Rich Hanley, AFSAA
1000 - 1050	WMD Web Site Brief and Demo	Mr. Walt Zimmers, DTRA
1100 - 1150	Discussion/Briefing Prep	Col Rich Hanley, AFSAA
1200 - 1300	Lunch	
1300 - 1350	Special Presentation	Mr. Eugene Visco, FS, Consultant
1400 - 1530	Working Groups Outbrief	
1530 - 1600	Synthesis Group Outbrief	

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Both days of the subgroup meetings were very busy and had a wide variety of briefings to support a common understanding of the issues. We were fortunate to have excellent presentations covering all four areas of interest. Interactions with decision-makers was not only ably addressed during the Plenary Session on Tuesday, but Mr. Doug Schultz presented an IDA study he led which looked at how CB should be quantified in the upcoming Quadrennial Defense Review. Mr Walter Zimmers showed how the Defense Threat Reduction Agency (DTRA) can support CB data requirements with both their classified and unclassified web sites. The results of three highly regarded CB studies were presented by Ms. Debbie Lott, Center for Army Analysis; Ms. Amy Hoeber, AMH Consulting; and Mr. John Lawrence, SAIC. LTC George Stone gave a presentation on how CB is being integrated into the future campaign model, JWARS. Finally, Dr. Martin Richardson spanned all four issues by discussing how uncertainties in data and algorithms affects the insights senior decision makers can draw from these studies.

Mr. Eugene Visco, FS, gave a special presentation to all four subgroups. During the two days of subgroup meetings, over six hours were devoted to questions, discussion of the issues, and ensuring attendees' perspectives were well represented in the final briefing..

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CB Ops Analysis Drivers



- Policy/Oversight/Integration:
 - DATSD(CBD) and CB MSOG (CoC first meeting 15 Feb)
 - Counterproliferation SOG (Tools subcommittee)
 - JSDAB- integration of data for DPG scenarios
 - JSIG and JSMG - integration of CB req'ts and models
- Who does the analysis?
 - Very dispersed, wide range of analytic levels
- Analytic support CB analyses
 - Current: DTRA; Services; Intel, CB medical and materiel communities
 - Needed: JSDAB, JDS, MSIAC, CBIAC

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Initial stages of the discussions centered on determining who were the main entities involved in CB analysis. Although there has been little policy or oversight in the past, recent developments show encouraging signs of improvement. Dr. Johnson-Winegar, DATSD(CBD), has been assigned responsibility for approving all common use CB models and simulations employed by the DoD. Consequently, she has decided to stand up the CB Modeling and Simulation Oversight Group (MSOG) and a MSOG Council of Colonels (CoC) to advise her. The Counterproliferation SOG (Tools subcommittee), the Joint Scenario Data Advisory Boards (JSDAB), and JSIG/JSMG may also be organizations that can assist in oversight and integration of CB model development and data collection.

Analytic support to CB modeling, simulation and analysis is provided by a wide variety of organizations: DTRA; the Services; and the Intel, CB medical and materiel communities. However closer integration and broader participation is needed to support CB analyses. Possible candidates for these roles are: OSD/PA&E Joint Data Support, JSDAB, MSIAC and CBIAC. Note: the role of CBIAC in support of CB modeling and simulation was addressed during and after the final briefing.

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Operational Objectives for CB WMD Analysis



- Force structure analysis - WMD environment on the campaign
- Trade off and system development
- Logistics - numbers of systems and locations
- Ops decision support

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The operational objectives of CB operational analysis was agreed to readily by the workshop participants. Most felt that these four objectives covered the range of activities and many attendees stressed the importance of each of these activities in ensuring senior-level decision makers are given appropriate insights on WMD issues. Many people pointed out the fact that using CB analysis to discover key insights in support of these objectives was difficult because of the problems that will be addressed later in this brief.

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OR Characterization of Threats and Effects



- Significant gaps in required data and processes
 - CONOPS non-specific
 - Technical details
- Unknown levels of uncertainties

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Most participants agreed that there were significant gaps in required threat data and processes. This is not due to a lack of support by Intelligence agencies, but rather a combination of factors. Many CB analysts have not communicated their requirements for data to the appropriate threat data producer. This is due to a lack of understanding of who produces the data and what processes need to be adjusted during this production. In particular, the Multi-Spectral Force Data (MSFD) development process should incorporate the production of required CB data. Not thinking ahead can be costly in this instance, as the MSFD can take up to two years to develop for a given scenario. Also, by not adequately informing threat data producers what specific information is needed, analysts run the risk of getting sketchy data or in some cases, no data at all. In particular, CB concept of operations (CONOPS) and technical data for threat countries have historically been lacking appropriate details to be incorporated into CB campaign-level analyses.

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CB Analysis Tools



- Large number of CB tools, from highly detailed to highly aggregated
- Too many, too simplistic, inconsistent and hard to use
- Users need more education
- Lack of mission model?
- Lack of BIO in any conflict models
- Distributed development process and not integrated
- Haphazard funding stream
- Lack of standardization (both methodology and data)

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There was wide agreement that campaign-level CB analysis tools have many problems and need to be improved to adequately support CB campaign modeling. This is actually understandable, since integration of CB effects into campaign modeling is a relatively recent phenomena. However, the detailed engineering and engagement models that are needed to aggregate CB data up to the campaign level, are plagued by problems (too many, too simplistic, inconsistent and hard to use) even though the algorithms they use have been around for more than 20 years. These problems are compounded by the fact that there are few CB education institutions that teach CB analysis techniques. Also, mission-level models that could bridge the gap between the engagement and campaign levels, do not exist. Besides assisting in the aggregation of the data required at the campaign level, they could be used to gain more detailed insights into the relationship of CB systems (suits, masks, CB detectors, active defense, etc.).

The participants agreed that there is probably no BIO analytic capability built into any campaign model. This problem may be caused by the distributed model development process and haphazard funding stream. However, the briefing by LTC Stone on JWARS points out that some of these problems will be solved in the near future.

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Shortfalls in CB Ops Analysis



- Past studies used inconsistent assumptions, data and methodologies
- No CB community standards
- No recognizable center of expertise
- Funding not targeted and integrated
- CB analyst career progression non-existent
- Lack of commonality between levels (engineering, engagement, mission and campaign)
- Lack of long-term unit behavior exercise plan (i.e. ground degrades)
- Lack of integrated technical data collection plan (i.e. droplet size)
- No standardized quality check on data and data sources
- Poor documentation and distribution of studies

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There were many problems affecting CB operational analysis. These notes will cover some primary issues. The lack of a plan for CB studies and analyst development will continue to plague CB analyses until a concerted effort is made to address these problems. Once those two problems are solved, many of the other problems listed on this slide will (hopefully) go away.

Unfortunately, some of these problems will take significant time, resources and funding. In particular, long-term exercise and data collection plans will require a strong commitment to adequately resource and fund. However, that commitment may be well worth the effort when it is compared to the effect this understanding of CB effects might have on our \$4B+ active defense program. The United States is spending significant resources to improve our ability to engage theater missiles at higher altitudes, without yet understanding if that capability is absolutely required.

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Key Insights



- Large investments occurring in the absence of critical data
 - e.g. active defense vs uncertainties of droplet size
- High job turnover rate and complex models = low expertise
 - e.g. 20% of WMD CST still 'model qualified' one-year later
- Uncertainties in analyses may have cost us our credibility
 - e.g. Colorado Rocky Mountain Arsenal

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The facts addressed on the previous slides leads to several conclusions. First, that large investments in active defense require better understanding of CB effects and data. No one yet understands what happens to thickened VX or other chemicals agents when they are intercepted at very high altitudes. The answer ranges from never coming down, to quickly falling to the earth. Of course, the best information is useless if we cannot provide our CB analyst with a stable work environment. We need to reduce attrition and increase the low level of CB analytic expertise. Otherwise, those decision makers needing solid CB insights will ignore our study findings because insights are inconsistent with other studies or not done in a timely manner.

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Recommendations for Investments to Improve Our Understanding



- Define real unit CB behaviors by integrated long term exercises
- Prioritize and fund technical test program and data collection
- Need formal integration and standardization of CB analyses
- CB rep on JSDAB and integration into MSFD development
- CB training and education for OR analysts
- Career progression plan for CB OR analysts
- Form networks of expertise
- Improve models

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The workshop's goal was to list current problems and provide actionable recommendations. This is our list of those things that can be done to improve the timeliness and fidelity of high spectrum campaign-level analysis. They won't be easy to accomplish and the workshop participants agree that it is unlikely that all of them can be done in the near future. However, implementing even a few of these recommendations will hopefully start CB analysis down the road to gaining back credibility which may have been lost and providing senior decision makers the insights they need to when addressing this difficult issue.

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CB WMD: Understanding the Analysis Problem



TRAINING SIMULATIONS and MODELS WORKING GROUP

Chairs

- Dr. Charles Ward, NGIC
- LTC Martin Bagley, DTRA

Support

Mr. Charles Allen, LOGICON

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- Col Steinmetz, DOMS CoMPIO
- Col Klewin, USA Chemical School
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- Mr. Evans, ANSER
- CPT Farrior, MANSSEN
- MAJ Hammett, HQ AF/XONP
- Dr. McNamara, GWU
- Dr. Reiter, DTRA
- Mr. Sheffer, Logicon
- Dr. Sheldon, Emergent IT
- Ms. Cronin, TSWG
- Mr. Stallings, DTRA
- Mr. Beitler, DIA

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Approach - Agenda - Presentations Presentations



- CoMPIO Training Issues Related to Simulation Models
- Chemical School Training Issues Related to Simulation Models
- WMD Simulators for US Army Chemical School
- 3-D Intel Tools Supporting WMD Targeting; Training Implications

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Objectives



- Determine how OR techniques can support characterization of CB WMD in training simulations and models.
- Determine what exists in OR capabilities to support civil and military training in CB WMD negation or response.
- Determine shortfalls in current or anticipated CB WMD analytical training tools or methodologies.
- Determine data sources, test results and study efforts that can assist in training model development.

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Training Simulations and Models Working Group Terms of Reference



- Tasked to address the opportunities that operations research products provide for training. These may span the gamut from distributed interactive simulations to computer-based learning and include operations models.

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Focus for Training Simulations and Models WG



- Coordinating training and operational tools in a multiple government agency environment, spanning from local to federal organizations; Addressed
- Evolution of computer tools for field and resident-site use (including 24 x 7 operations centers) Addressed
- Teaching and using scientific and engineering WMD models and simulations; Addressed
- Impact of "distant learning" and other new training technologies; Addressed
- Certification and re-certification of these models and training in general; Not Addressed

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What are the Problems? - Key Insights -



- ❑ What are the shortfalls in CB training?
 - ❑ Realism: How much is enough?
 - ❑ Commonality: M&S based training and simulation tools must coincide with operational M&S tools.
 - ❑ Sustainment: CB skills are uniquely perishable.
 - ❑ Scenario development: Current work lacks sufficient breadth and depth; “playbook.”
 - ❑ Metrics: How does one define and measure success?

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One needs to do a trade study on specific applications to determine required realism.

Can the M&S tools handle all the details?

Consistent OR based methodologies to solve this problem are required.

Accurate and most probable scenarios are essential.

Success measurements will be different for different agencies.

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Assessment of the Current State-of-the-Practice



- Use of OR Tools in WMD Training: Exploiting “lessons learned” from WMD training requires additional effort
- WMD Training of Tools: Mismatches continue between skills required and student readiness (High turnover). Instructor training methodologies require additional focus.
- Interoperability: Making progress, are we going fast enough and are we broad enough?
- Data Collection: Many issues - intragovernment laws and regulations, resource shortfalls, maintenance and many others!

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Advance Distributed Learning (ADL) standards

Certification and re-certification standards among intragovernment agencies will be challenging!

High Turnover in WMD CST modelers (3 year enlistment, however, less than 20% left of original 10 teams!) What will be the turnover rate of the 17 new teams?

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Recommendations to Improve Our Understanding



- ❑ OR should identify optimal training methodologies (from soldier to leader). Consistent OR based methodologies and trade studies are required.
- ❑ OR should be used to identify the gaps and limitations
 - ❑ Aggregation of real time feedback, testing AAR data can help to identify where students and instructors are having problems.
 - ❑ More detailed studies will help pin point source limitations of the system, training tool requirements and/or TTP development, as well as other potential solutions
- ❑ OR may assist in determining the balance between fixed and free play elements within scenario development.

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In the civil support role, coordination with local and state essential for “buy in.”

Fixed and free-play training techniques are useful but need to be evaluated in the entire training and simulation environment.

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Key Drivers

Not an inclusive list



Key Drivers	Developer	User
USACMLS	X	X
AMEDD	X	X
CINCs		X
Joint Staff		X
TSWG,FEMA,DOJ	X	X
State/Local		X
CB CAM /CAWG	X	
DTRA	X	
NGIC	X	
DOE	X	

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Current and Proposed Developments in Analysis Tools



- JACE and CATS are merging (Geospatial Info Systems)
- VLSTRACK, D2PC and HPAC are merging (Joint Effects Model)
- Army-led NBC Crest development to meet Joint requirements
- Commonality in formats of CB detectors and predictive models in a virtual interactive environment will lead to more realistic simulation and training.

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OR Characterizations of WMD Training



- OR can define the process to develop the degree of realism needed for sensor and environment representations used in training.
- OR can aid training by identifying the gaps in knowledge and defining resource allocation to generate solutions.
- OR can define the value of proposed M&S solutions to training limitations. Within proper caveats, OR can validate less than perfect simulations for training purposes without losing the balance of: "*Train as you fight, fight as you train.*"

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Example: Defining levels of accuracy and detail for urban modeling, including interface between plume propagation and lethality or incapacitation models.

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Proposed Analysis Efforts



Studies - Demonstrations - Tests - Data Collection

- OR Efforts with Immediate Utility
- Optimal ways to evaluate and prioritize industrial source terms; most probable threat (intra-government issue)
- Evaluate current CB modeling quality (how good is good enough)
- Continued evaluation of CoMPIO CB training requirements based on WMD-CST efforts in training process.
- Identifying equipment and training standards is essential in an intra-government environment.

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Actionable Questions



- How well does CB WMD modeling and simulation support training requirements for US/other forces and civil support?
- What are the data gaps? How can analysts define the varying degrees of uncertainty within CB weapons and effects?
- What are the current efforts in CB WMD training and simulation tool development? How are they prioritized?
How can the community anticipate needs for tool development and what are the OR analyst roles?
- How can OR methods assist capturing lessons learned from training into the acquisition process?

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CB WMD: Understanding the Analysis Problem



Simulation Based Acquisition

Chair

➤ Michael O. Kierzewski

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Approach - Agenda - Presentations



31 January 2000

0800-0830	Introduction and Working Group Overview (Mike Kierzewski, OptiMetrics, Inc)
0830-0915	Simulation Based Acquisition Overview (John White, SBCCOM, SBA lead for JSMG)
0915-1000	Working Session: SBA Concept
1000-1015	Break
1015-1100	M&S-Based Data/Information Architecture for Ship Design and discussion (Myles Hurwitz, NSWC Carderock)
1100-1200	SBA Plans for the Artemis Program and discussion (Michael Abate, NSWC, Artemis PM)
1200-1300	Buffet Lunch
1300-1400	Working Session: SBA Plans
1400-1500	ADW Program Overview and Modeling Tools and discussion (Frank Fairchild, AF NWCA, (Orion International Technologies, Inc))
1500-1515	Break
1515-1600	SBA at the Virtual Proving Ground, M&S of CB Point Detectors and discussion (Tom Evans, Virtual Proving Ground (Battelle))
1600-1700	Working Session: SBA Applications and Hotwash for Day 1
1700	Adjourn for Day
1715	Working Group Chairs' Hotwash

1 February 2000

0800-0830	Introduction and Review of First Day (Mike Kierzewski, OptiMetrics, Inc)
0830-1000	Working Session: State of the Art and SBA Requirements
1000-1015	Break
1015-1200	Outbrief Working Session
1200-1300	Buffet Lunch
1300-1400	Presentation by Mr. Gene Visco, FS in Auditorium
1400-1530	Working Group Brief-outs
1530-1600	Synthesis Working Group Brief-out
1600	Adjourn Workshop

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General approach was presentations followed by group discussion.

Proceeded from general discussion of defining SBA to plans for utilizing SBA and finally example applications of SBA.

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Participants



Michael Kierzewski	ECBC/ OptiMetrics, Inc	James Mays	NSWCCD
Dennis Jones	ITT Industries	Christine Fossett	US GAO
Michael Abaie	PD Artemis	David Evans	DATSD CBD/ANSER
Tom Evans	DPG/Battelle	Tucker Battle	Consultant
Jim King	CBIAC	Ross Amico	DTRA/LOGICON
COL Pete Bucha	AMSAA	Ron Ferek	ONR
COL Paul McVickar	HQ AMC USAF	MAJ Steve Charbonneau	CAA
Nate Licata	BAH	Dave Lueck	JSIG/Battelle
Frank Fairchild	NWCA/ORION Inc.	LTC Bruce Bowman	J8
CDR Tom O'Donnell	OPNAV N76DC	Steve English	JSMG
Scott Carey	NSWC	Walton Dickson	MANSCEN
David Hartline	AAC/CACI	John White	ECBC (JSMG)
Myles Hurwitz	NSWCCD		

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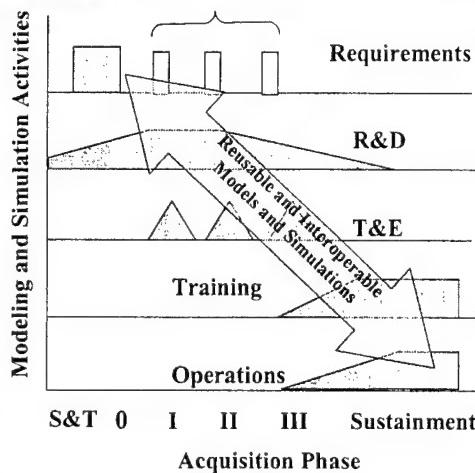
The participants represented a mix of simulation developers and the materiel developers that utilize the analytical results from SBA tools and studies. Good representation across the services and various other DoD agencies. No direct representation from first responders or other agencies involved in the Homeland Defense arena. Queries to several non-DoD federal agencies revealed no apparent overarching concept of SBA being applied outside of DoD.

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Simulation Based Acquisition



Military Worth Studies



- Element of DoD Acquisition Reform Initiative
- M&S performed for all developmental items throughout all acquisition phases
- Reusable and interoperable M&S in Requirements, RDA, Training and Operations
- Sustained user interaction through Military Worth Studies
- Significant time and cost savings in T&E activities
- Enhance system performance and reduce total ownership costs
- Overcomes environmental constraints for CB testing

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One of our first tasks was to agree on what we meant by Simulation Based Acquisition. In it's broadest sense, SBA encompasses the simulation supported analyses and testing for everything from initial concept development through the decision to finally retire a system from service. The goal is simulation tools to support analysis, testing and training that mature with the technology/system and are interoperable and reusable. The acquisition analyses and decisions themselves are basically the same whether supported by simulation or the more traditional paradigm of iterative build, test and redesign.

For the purposes of our discussions, we concentrated on SBA in the R&D and T&E phases with some discussion of requirements generation and refinement. Models and simulations used in training and operations were covered to some extent by the other working groups at the workshop.

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Stakeholders



- Primary
 - Warfighter/ First Responder
 - PM
- Secondary
 - OSD CB Steering Committee/ MSOG
 - JSMG, M&S CAM
 - JSMG IT BAM
 - S&T Community
 - Industry

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We grouped our stakeholders into two tiers. Primary stakeholders are those who have to live with the acquisition decisions made based on application of SBA. Secondary stakeholders are those who develop SBA tools or use them. PM's actually span the tiers because they are users of SBA that comes out of the Technology Base and they may also have to develop additions/modifications to meet their milestone decision needs.

The secondary tier stakeholders have distinct roles within SBA.

Of course policy is set by the OSD CB Steering Committee and MSOG.

The JSMG CB M&S CAM oversees the development of mature SBA tools for general use across the CB combat and materiel developments community.

The JSMG IT Business Area Manager (BAM) oversees the 6.2 and 6.3 work developing the M&S technologies to be used in SBA. This is essentially the M&S Tech Base.

The S&T community is charged with creating and updating the simulation representation of their technologies as these technologies mature. This enables the S&T community to demonstrate their “wares” in such forums as Advanced Warfighting Experiments and solicit early user feedback on the combat utility of their developmental systems.

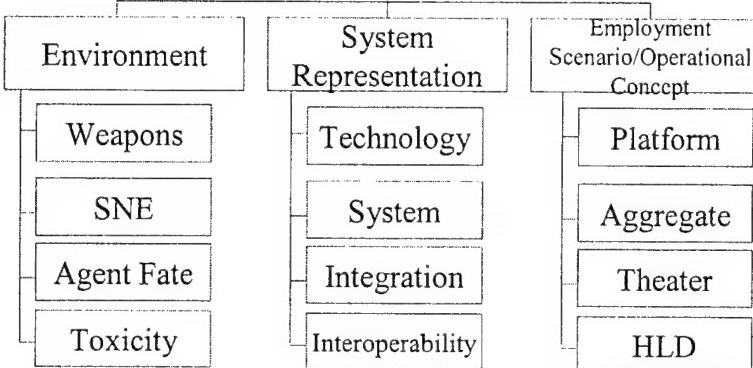
Industry is involved both as supporting contractors to the various government agencies and as developers of interface standards and synthetic environments.

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Operational Objectives for CB WMD SBA Analyses



Analysis of Systems and Technologies



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The objectives for CB WMD SBA analyses are the same as for more traditional methods such as prototyping, testing and wargaming: a determination of what benefit or utility the technology/system provides for the warfighter (or first responder in a Homeland Defense scenario). Particularly for SBA, the questions are:

- What design changes improve this military worth?
- How much does current technology need to improve to provide a benefit? This can often serve as a feasibility check as to whether or not it makes sense to continue development in a technology area.
- As designed, does the new system address the need it was built for? This analysis may highlight doctrinal or employment concepts that need changing to take full advantage of the new materiel system.

For this determination of military worth you need the following components:

- Operating environment to include the CB weapons (or toxic industrial chemical); a synthetic natural environment to include weather, terrain and urban; agent fate and toxicity data. To evaluate many types of detection systems, the agent hazard must be presented in a dynamic method that mimics the natural variance and stochastic nature of agent attacks or incidents.
- Next the technology or system to be evaluated must be in a simulation that can interact with the synthetic environment and produce outputs, warnings, etc. as the real system would. This virtual system must integrate with other virtual systems as they would be employed (detection system, integrated with its prime mover and communications system for example) and must be interoperable with a wide range of operational simulations or other materiel systems under development.

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Operational Objectives for CB WMD SBA Analyses



Analysis of
Systems and
Technologies

Requirements
Analysis

Trade Space

AoA

Evolutionary

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- Then the operational concept or employment scenario must be expressed in the simulation. For instance the command and control systems and other combat systems that the CB defense system will support must be represented to a level of fidelity that allows accurate evaluation of the CB defense system's contribution to the overall warfight. This operational concept can range from the Tactics, Techniques and Procedures (TTP) employed by single vehicles or small units, to the strategic concerns of a theater commander. Additionally, outside the traditional war fighting scenarios, we must be able to represent the operations and decision making that occur during missions like homeland defense.
- The final major portion of the SBA puzzle is the iterative process in which requirements and the systems to meet those requirements are finalized. This process begins with Milestone A and continues until a final set of requirements has been determined and the materiel developer is well along in designing the final system to meet those requirements. What is required in this stage are tools that can quickly evaluate how well various technologies or system designs meet requirements. These have to be some quantification of how well requirements are met or not met to enable trade-offs. Can't be just a binary GO/NO GO decision.

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Current and Proposed Developments in Analysis Tools (TOC Model)



- ❑ TOC (total ownership cost) model being developed by the Artemis program
 - ❑ Currently developing model for AoA
 - ❑ Non-system specific model
 - ❑ Evaluate variety of technologies
 - ❑ Provide a ROM TOC for the Warfighter
 - ❑ Revise model to be system specific
 - ❑ Post AoA and during entire SDD phase
 - ❑ Run model during Acquisition cycle
 - ❑ Issue: Robust TOC model for AoA evaluation

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Product system object model at Naval Surface Warfare Center-Carderock Division.

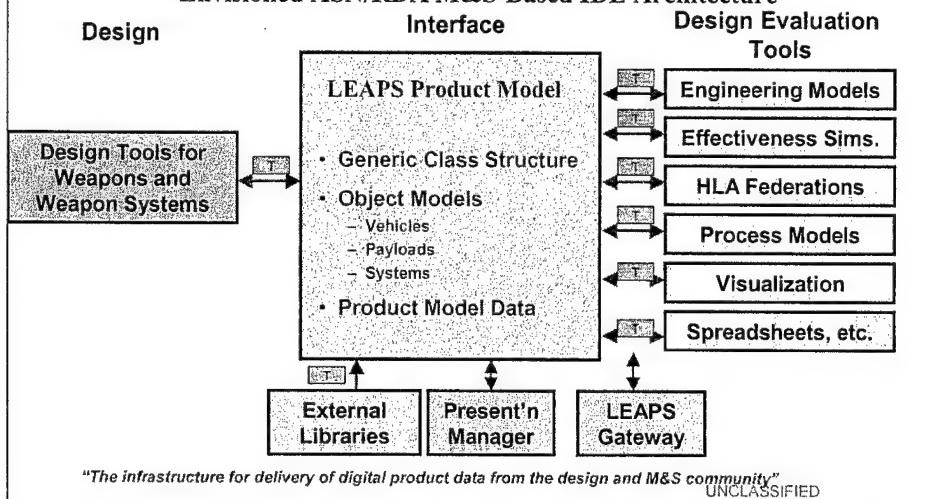
Defense Evaluation Research Agency.

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Current and Proposed Developments in Analysis Tools (LEAPS)



Envisioned ASN/RDA M&S-Based IDE Architecture



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Leading Edge Advanced Prototyping for Ships/Systems (LEAPS).

LEAPS is a highly robust, generic object-oriented information structure for product modeling, used to develop product object models.

LEAPS is a set of product object models used to develop and access product virtual representations (currently, only a surface ship object model is developed).

LEAPS is an integrated M&S architecture.

LEAPS can be populated with design and design evaluation data and comprehensive data relationships.

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Current and Proposed Developments in Analysis Tools (CB in Urban Terrain)



- Several agencies in both the US and abroad are pursuing better M&S to represent the effects from chemical/biological agents released in urban terrain
 - DOE (Department of Energy)
 - NGIC (National Ground Intelligence Center)
 - DTRA (Defense Threat Reduction Agency)
 - UK DERA (United Kingdom Defence Evaluation and Research Agency)

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As we fully expect urban terrain to play an increasing role in combat and other than combat operations, the ability to evaluate CB concepts and materiel in a synthetic urban environment becomes critical.

This ability is crucial not only for deployed forces but can also aid civilian and military assistance planners for Homeland Security operations in the US.

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Current and Proposed Analysis Efforts with Extensive M&S



- Analysis of Alternatives (AoA) for the Artemis standoff chemical biological detection program.
- AoA for the USAF Agent Defeat Weapon program
- Concept and materiel evaluations for the Future Combat System being performed by the Maneuver support Center (MANSCEN)
- Advanced Concept Technology Demonstrations (ACTDs) such as Restoration of Operations (RESTOPS)
- Molecular modeling of sensor interactions at the Dugway Proving Ground, Virtual Proving Ground project

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Shortfalls in CB WMD Analysis



- Funding (.1% inadequate to support transitions and common use tools)
- Closer linkage between policy and early concept/employment scenario development
- Urban synthetic environment (coordination/integration)
- Linkage between our current tools and larger Warfight simulations (JSIMS / JWAR)
- Agent fate and low level toxicity
- Certified data/standards for model VV&A

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Funding. Currently no overall program exists to resource the development of robust common use tools for SBA. When specific programs must fund and develop their own SBA tools, the understandable (from the PM's perspective) tendency is to spend the minimum on documentation, interface and making the tools applicable across a wide range of systems. Common use tools such as the synthetic environment, and generic representations of CB defense equipment, if developed independently of specific programs would facilitate the reuse that is one of the tenets of SBA. In addition, PM's and Milestone Decision Authorities (MDA) would be better able to make comparative decisions knowing that the underlying M&S used for supporting analyses was widely used, its strengths and weaknesses known, and basic VV&A accomplished. Specific developmental systems would have to fund additions to the basic tools, but these could also be folded back into the common use tools.

Closer Linkage. Particularly as we move into areas of counter-proliferation, active defense (destroy CB weapons before they can be used against us), and counterterrorism, a close linkage between the materiel developer and policy experts needs to be established. The limiting factor in a situation could very well be what is politically acceptable, not technology limitations.

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Assessment of the Current State-of-the-Practice



	Military	Civil Support*
Metrics	<input type="circle"/> Y	<input type="circle"/> Y
Threats and Effects	<input type="circle"/> Y	<input type="circle"/> Y
Scenarios	<input type="circle"/> Y	<input type="circle"/> Y
Data Collection	<input type="circle"/> R/Y	<input type="circle"/> R/Y
Analysis Tools	<input type="circle"/> Y/R	<input type="circle"/> Y/R
Methodologies	<input type="circle"/> G/Y	<input type="circle"/> G/Y

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* The WG had no civil support representation so these are based on our ratings of the military specific applications. Since we were unable to identify an overall policy or direction regarding civil support simulation based acquisition, we felt certain that the status could be no better than the military applications.

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How Well Do We Understand the Problem? - Key Insights -



- Individual parts of the problem are fairly well understood (except for deficiencies noted elsewhere)
- Integration of the enabling M&S tools to support analysis is the key overarching impediment

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Recommendations to Improve Our Understanding



- Promulgate guidance, procedures and funds to develop an architecture to transition/integrate system specific M&S to large warfighting/training simulations (#1, 4)
- CAM develop, maintain and disseminate the common use tool chest because cost for SBA tools is prohibitive if each program develops own tools (#11, 12). Utilize existing repositories. Examples of common use include:
 - Urban environment
 - System performance / human performance degradation
- Ensure technologies transition with their M&S (if applicable) (#10) For example make this a portion of exit criteria for ATD, ACTD.

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The numbers within parentheses, are the paragraph numbers for the responsibilities outlined in the charter for the Modeling and Simulation Oversight Group (MSOG).

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CB WMD: Understanding the Analysis Problem



Synthesis and Integration Working Group

Chairs

- Christine Fossett, FS, GAO
- Bruce Bennett, RAND

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In trying to understand the problems with analysis of chemical and biological weapons, the objectives of the Synthesis and Integration Working Group were:

- To ensure that the working groups focused on their objectives.
- To ensure that working groups focused on the data and analysis needed to inform policy decisions, but not make policy pronouncements.
- To identify major omissions or overlap and to discuss these with working group chairs.
- To summarize observations, etc. across groups.
- To share our knowledge and expertise with the working groups.

We have chosen in this briefing to take a strategic perspective, focusing on the overall problems as we observed them, and in particular on the solutions we recommend.

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Members



- Bruce Bennett, RAND
- Christine Fossett, FS, GAO
- Gregory Keethler, ARA Inc.
- Julian Palmore, Univ. of Illinois at Urbana
- MAJ Jon Pool, SBCCOM/CBRRT
- Robert Sheldon, Emergent IT
- LTC George Stone, OSD/PA&E JWARS
- Eugene Visco, FS

We audited the other groups

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The members of the working group were those you see on the slide. In addition, we were assisted by Julia Klare Burr, IDA; Dr. Tom Allen, IDA; and David Evans, ANSER.

The members not only observed the working groups, but participated in their discussions as well. Periodic meetings were held to review and assess progress and findings, and these were synthesized as presented in the following slides. Overall, the working groups had informative briefings and constructive discussions that focused on their respective objectives: operations, training and acquisition. The commonalities in their observations and recommendations indicates systemic issues in the spectrum of CBW analyses.

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What Is the Problem?



- Overwhelmed by a fundamental lack of CBW knowledge/information
 - The body of knowledge is not well defined/structured
 - Filling the gaps is difficult (e.g., testing is limited, prediction is tough)
- Lack of analytic framework to guide analysis
 - Uncertainty is pervasive and must be addressed/managed
- Inconsistent models, tools and data
- Limited “reality” information complicates validation
- Inadequately organized expert community
- CBW analysis is commonly underplayed

Uncertainty
pervades

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The fundamental lack of CBW knowledge is often characterized as a “data” problem, but this makes the problem seem more trivial than it really is. This knowledge problem is not unique to the area of CBW — other areas like EW and C4ISR have the same fundamental problem — however CBW offers some unique challenges. CBW data is derived from a basic body of knowledge, the analytic framework for which (the structure and nature of the content) is often lacking in areas such as transport physics, biological effects from CBW exposure, agent fate (persistence), individual performance degradations, group performance degradations, psychological effects, and the effects of protective equipment on performance/ endurance. In these same areas, we have an incomplete characterization of CBW phenomenology, and many gaps in the knowledge base. These gaps leave significant uncertainties that must be managed. The gaps in these areas exist in part because testing is often not possible, and prediction of the environment and other factors is difficult.

As a result, many of the CBW models, other tools, and data are inconsistent with each other. While validation is called for to resolve such problems, it is unlikely to do so because we usually don’t know the “real world” against which to validate the models and data. These problems are exacerbated by an inadequately organized and supported expert community.

Most Defense Department analyses tend to underplay CBW threats (often ignoring them entirely) because of these difficulties and the potential costs of resolving CBW threats.

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Recommendations: Structuring the Chaos



- Central leadership needs to direct efforts
 - Establish analytic frameworks by application type
 - Address knowledge management limitations
 - Data, analytic difficulties
 - Establish CBW validation standards
 - Organize, fund, and use community experts
 - Basic and advanced CBW and analytic training
- Inter-/intra-nationalize CBW analysis
- Define goals, measures of merit for 2005, 2010

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This slide is an outline for the remainder of our presentation.

The Defense Department has two objectives for countering the CBW threat: Institutionalizing responses within DoD, and internationalizing responses with US allies. With regard to the first, we recommend that the DoD leadership take the actions shown under the first bullet to firm-up the knowledge base, fill-in gaps, revise the validation process, and deal with personnel and training issues.

We recommend that the internationalize process be pursued, but also that these analytic procedures, data and other tools be made available to the US civil community ("intranationalize") who face many of the same barriers.

Finally, we recommend that specific goals in these areas be established and measures of merit be defined to monitor progress over the next decade.

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Recommendations: Analytic Framework (Application Types)



- ❑ War planning and homeland security
 - ❑ Robust plans across uncertainties
 - ❑ Identified branches and sequels where needed
- ❑ Crisis/consequence resolution
 - ❑ Updated condition description, outcome learning
 - ❑ Best estimates for requirements, hazard assessment to guide mitigation
- ❑ System acquisition
 - ❑ Robust acquisition choice, recognizing risks
- ❑ Training
 - ❑ Exposure to most likely outcome and range
- ❑ Etc.

All need
exploratory
analysis

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The CBW analytic framework will be a function of the type of application. For each type, an approach featuring exploratory analysis needs to replace best estimate analysis and be used to determine robust choices and manage risk. As exploratory analysis is undertaken for each application, commonalities across applications should be identified to help provide a broader context for the body of knowledge across the CBW spectrum. Also, we need to integrate new applications as they emerge, such as the military's support for Homeland Security operations.

Underneath this approach, a framework that defines the issues and interactions (real world) needs to be developed for each application. Then a conceptual model of that world should be developed followed by a simulation model with specifications regarding the data and information needed. This becomes part of the foundation for the repository. For example, with regard to ground combat, CBW primarily affects the ground combat personnel. However, the killer-victim scoreboard ground combat models are based upon the destruction of vehicles or infantry arms shooters, missing many of the potential victims (especially support/headquarters personnel somewhat to the rear). Thus, the framework needs to define how the effects of CBW will affect ground combat in the framework of models which generally do not track casualties separately from weapon systems. Also, CBW affects the infrastructure, equipment and places where combat takes place and extends to other locations. For example, the Air Force is very concerned with CBW effects on aircraft and airfields, and how to clean them.

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Recommendations: Addressing Data, Analytic Difficulties



- ❑ Use the frameworks to pinpoint knowledge gaps
- ❑ Develop data values, model/analytic methods
 - ❑ Experiments, Exercises, ACTD's, DT&E/OT&E, etc
- ❑ Establish central data, analytic repositories
 - ❑ Approved data values and ranges
 - ❑ Models/analytic methods
 - ❑ Foster continuous community visibility/review/debate
- ❑ Adjust approach to threats, intelligence
 - ❑ Move from “confirmed” point-estimate threats to best estimates with a range of alternatives

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The next step with the data and analytic difficulties is to determine the gaps in our knowledge from the frameworks and to prioritize efforts to fill these gaps. Continuing to approach our studies in a haphazard manner is not an efficient way to accumulate our CBW knowledge. This “knowledge” can develop in stages, first replacing the estimate of “it doesn’t matter” with a rough estimate, followed by tests, experiments, exercises, evaluations, etc. For example, the RESTOPS effort at Osan Air Base will serve as one such data source. Studies can further test new methods and analytic approaches in areas where past approaches have not been very fruitful.

To capture what is known, we need a virtual (as opposed to physically consolidated) CBW information repository. This repository would provide the basis for reviewing data, models and methods — to establish best practices, and where possible, approved or standard data values and ranges that can be used by the analytic community. Another important aspect of the repository is visibility — it should be open for other experts to review findings, and to challenge with questions, alternative explanations, or other (historic or new) data. Hopefully other (dissenting) opinions would lead to constructive debate about the issues, an informed discussion of the problems, and a focus for future studies. A “Center of Excellence” could be designated to centrally manage (adjudicated) most data/info.

Traditionally, intelligence estimates are based on confirmed, point estimates. In the CBW area, confirmed estimates are hard to achieve, making such estimates generally very dated and conservative. We need to consider shifting the basis of CBW intelligence to best estimates based upon related information, with a range of alternatives from confirmed point estimates to “cannot disprove” cases.

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Recommendations:

Establish CBW Validation Standards



Problem

- CBW “real world” difficult/impossible to establish
- Compounds already formidable problem, even at the technical level

Solution

- Establish standards to substitute for reality
- Include a range of conditions to address uncertainty
- Validate against both, identifying risks
- Support accreditation with appropriate risk assessment/management

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Validation is defined as “the process of determining the degree to which a model is an accurate representation of the real-world from the perspective of the intended uses of the model.” However, in the military operations area in general and the technical aspects of CBW as well, it is often difficult or impossible to define what the “real world” is or would be (e.g., who can tell what the next war in Korea will be like?). Even at the technical level CBW issues are nothing like validating an engineering-level model of a system that can be tested in the real world, since many aspects of CBW cannot currently be tested and the environment in which they would be used cannot be precisely predicted.

We recommend that standards be established as a substitute (proxy) for the “real world” for CBW effects. These standards should include a range of conditions to reflect the inherent uncertainties in CBW. Models and other analytic tools should then be validated against such standards, identifying the risks associated with using standards short of the “real world.” For example, if we anticipate conflict in a casualty averse climate, the uncertainties associated with proxy validation raise the risk that casualties could be (much) greater than estimated.

Validation is supposed to underpin accreditation of models for any given application. Recognizing the limitations of validation and similar complications in accreditation, accreditation efforts should include an explicit risk assessment/risk management plan for each model/analytic application. The DMSO prescribed V&V methodology should be reviewed and adjusted to meet such a standard, and then used for each application and model.

Recommendations: Community Experts and Training



- Multi-disciplinary expert groups
 - Technical data, model groups
 - Experts on agents, transport, physical effects, etc.
 - Operations groups
 - Experts on how effects impact civil ops and military ops
 - Develop groups, grow over time
 - Establish a recognized “area of expertise” and associated career paths to foster continuity
- Training
 - Develop basic analytic training material (primer, classes)
 - Develop advanced training material
 - Develop military/civilian certification program

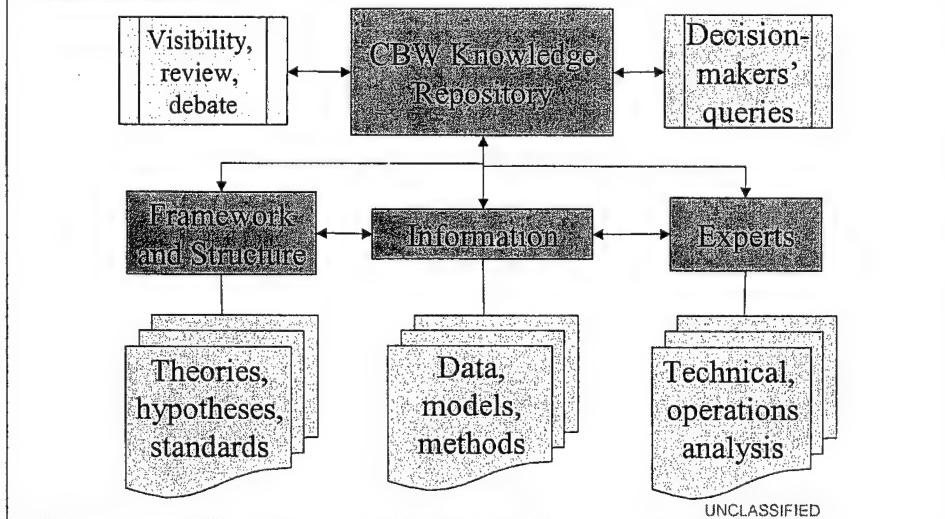
You cannot resolve the problems addressed above without better organizing and exploiting the experts in CBW. Some of these experts focus on the technical weapons data, such as the nature of the agents, how they are transported in the air, their physical effects on people, and so forth. Other experts focus on how these weapons would impact military or civil operations. These experts need to be organized into “virtual groups” that meet occasionally, but more importantly work in teams in a collaborative manner to address the deficiencies above. These experts need stable tasking and funding to preserve and build the “institutional” knowledge. They need to be recognized as being part of an area of expertise with a clear career path. They also need to have an apprenticeship/mentoring program to bring new personnel into the field to generate an expanded, new generation of experts, especially since a number of existing experts are near or past retirement.

A related issue is training. Most CBW analysts need basic training in CBW, and the experts need to assist in the preparation of primers and classes that explain the issues and interactions at both a technical and operational level for military and civilian analysts. The NBC-related training at Ft. Leonard Wood provide good starting points. Advanced training materials are needed for those who will perform CBW analysis with specific tools, and those who will consume that analysis.

These materials can be used as a basis for a military/civilian certification program in various CBW areas. For analyses where validation will always be imperfect, the analyst will have a significant role in properly framing and executing the analysis. In some cases, his role will be more important than specific models or data, and thus we need to assure that the analyst is at least as ready to perform the job as is the model, data, and other analytic tools.

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CBW Knowledge Management



This chart provides a diagram of some of the relationships we propose. A CBW knowledge repository is needed which allows for broad access. It should provide a framework and structure for the knowledge and contain information on relationships, parameter values and models. It should be supported by a group of experts in both technical and operations areas who help fill the knowledge/information gaps from the scientific literature, extract information from experiments and exercises, and validate proposed information.

DMSO and AMSO have good concepts and plans on how knowledge repositories should be built for M&S. Jack Sheehan, DMSO, and Del Lunceford, AMSO, could provide information and guidance in this respect. They have already established procedures and spent funds on such an endeavor, of which CBW is one area. Their work on CBW should in particular be reviewed.

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Recommendations: Inter-/intra-nationalize CBW Analysis



Problem

- Models/tools and data are often classified or “US Only”
- Doctrine, CONOPS, TTPs, data of allies not reflected
- Civil/Public participation/communication is limited

Solution

- Reduce the model/data transfer impediments (e.g., at least require a releasable version)
- Actively pursue public release where possible
- Need to pursue developing ally information and data
- Institute a public affairs program (demystify)

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The second broad Defense Department objective for countering the CBW threat is to internationalize the US efforts. We add here the process of “intranationalizing” efforts to cover CBW analysts outside of the Defense Department dealing with civil support. In both of these areas, dissemination of the models/tools and data are often limited by classification and/or the “US only” caveat. Moreover, the models and data often fail to properly reflect the doctrine, CONOPs, forces, and other aspects of the allies with whom we would fight. And participation and communication with the civil/public communities is limited.

To reduce these problems, model developments should seek to avoid classification or “US only” restrictions, and where these are needed, contracts should require the development of a civil/foreign releasable version. These versions can then be shared with allies in exchange for the allies’ efforts to represent their forces properly. Finally, a public affairs program is needed to demystify CBW for US and foreign audiences.

In sharing models and data, we need to be cognizant of communication challenges — differences in language/terminology can lead to serious misinterpretations. It behooves analysts to become familiar with the languages and terminology of our new collaborators, including NGOs, PVOs (in peace support functions), state and local governments, and non-military federal government officials (in the counter-terrorism and homeland security functions).

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Recommendations:

Goals, Measures of Merit for 2005, 2010



- Problem
 - Need to track our progress
- Solution
 - Establish 5, 10 year goals
 - Develop measures of merit for each goal
 - Report/reevaluate at least yearly

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There is a long way to go in resolving the CBW knowledge and other limitations discussed in this brief. We need to be able to track progress as we undertake these new efforts and invest resources.

In coordination with describing an analytic framework, goals for resolving limitations need to be established along with measures of merit to follow the progress that is made. These measures should be assessed at least yearly, reviewed, and reevaluated to make sure the overall effort is on track, and to adjust goals and efforts where needed.

Conclusion

Some will read what we have written and argue that even our recommendations will not fully resolve the problems, and yet they will involve significant efforts and costs; therefore, it would be better to do nothing. We most strongly disagree. While there will be efforts and costs associated with improving CBW analysis, we believe that in the long-run these will most likely yield efficiencies and perhaps even defense savings (especially in reducing duplicative, contradictory work), and may well help save the lives of many people by properly reflecting CBW vulnerabilities and what can be done to correct them. It is true that complete resolution of the knowledge gaps and uncertainties is not possible, but enough can be done to yield substantially better and more effective analyses of CBW issues. To fail to do so would violate our responsibility as analysts to provide the community with analysis upon which decisions can meaningfully be reached.



Chemical-Biological Weapons of Mass Destruction: Understanding the Problem

Acronyms

AAR	After-Action Review
ACTDs	Advanced Concept Technology Demonstrations
ADW	Air Defense Warfare
AFSAA	Air Force Studies and Analysis Agency
AMEDD	Army Medical Department
AMSO	Army Model and Simulation Office
AoA	Analysis of Alternatives
ASD (RA)	Assistant Secretary of Defense (Reserve Affairs)
ASD (SO/LIC)	Assistant Secretary of Defense (Special Operations and Low Intensity Conflict)
ATD	Advanced Technology Demonstration
ATSD (CS)	Assistant to the Secretary of Defense for Civil Support
BAM	Business Area Manager
BDA	Battle Damage Assessment
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CAA	Center for Army Analysis
CALL	Center for Army Lessons Learned
CAM	Chemical Agent Monitor
CATS	Crisis Action Team(s)
CB	Chemical and Biological
CBIAC	Chemical Biological Information Analysis Center
CINC	Commander in Chief
CMI	Consequence Management Interoperability
CoC	Council of Colonels
CoMPIO	Consequence Management InterOperability
CONOPS	Concept of Operations
CONUS	Continental United States
CSEPP	Chairman of the Joint Chiefs of Staff – Sponsored Exercise Program
CST	Civil Support Team

DATSD (CBD)	Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense
DepSecDef	Deputy Secretary of Defense
DMSO	Defense Modeling and Simulation Office
DOE	Department of Energy
DOJ	Department of Justice
DT&E	Developmental Test and Evaluation
DTRA	Defense Threat Reduction Agency
EW	Early Warning
FEMA	Federal Emergency Management Agency
FS	Fellow of the Society, MORS
GAO	Government Accounting Office
GIS	Geographic Information System
HLA	High Level Architecture
HLD	Homeland Defense
IDA	Institute for Defense Analyses
IEEE	Institute of Electrical and Electronics Engineers
JACE	Joint Alternate Command Element
JDS	Joint Decision Support
JHU/APL	Johns Hopkins University Applied Physics Laboratory
JSDAB	Joint Scenario Data Advisory Board
JSIG	Joint Service Integration Group
JSIMS	Joint Simulations Systems
JSMG	Joint Services Material Group
JTF-CS	Joint Task Force -
JULLS	Joint Universal Lessons Learned System
JWAR	Joint Warfighting
LEAPS	Leading Edge Advanced Prototyping for Ships/systems
M&S	Modeling and Simulation
MANSCEN	Maneuver Support Center
MDA	Milestone Decision Authorities
MOE	Measures of Effectiveness
MSFD	Multi-Spectral Force Data
MSIAC	Modeling and Simulation Information Analysis Center
MSOG	Modeling and Simulation Oversight Group
MTW	Major Theater Warfare
NBC	Nuclear, Biological and Chemical
NGIC	National Ground Intelligence Center
NGO	NonGovernmental Organization
NRT	National Response Team
OCONUS	Outside the Continental United States
ONR	Office of Naval Research
OSD/PA&E	Office of the Secretary of Defense/
OT&E	Operational Test and Evaluation
PDD	Presidential Decision Directives
PM	Program Manager

PPE	Personal Protective Equipment
PVO	Private Voluntary Organizations
QDR	Quadrennial Defense Review
R&D	Research and Development
RC/NG	Reserve Component/National Guard
RDA	Remote Database Access
RESTOPS	Restoration of Operations
ROM	Rough Order of Magnitude
S&T	Scientific and Technical
SBA	Simulation-Based Acquisition
SBCCOM	US Army Soldier and Biological Chemical Command
SOG	Special Operations Group
SSC	Small Scale Contingency
T&E	Testing and Evaluation
TICS	Target Information Center(s)
TIMS	Tactical Information Management System
TOC	Total Ownership Cost
TSWG	Technical Support Working Group
TTP	Tactics, Techniques and Procedures
UK DERA	United Kingdom Defence Evaluation and Research Agency
USAF	United States Air Force
USD (AT&L)	Under Secretary of Defense for Acquisition, Technology and Logistics
V&V	Verification and Validation
VV&A	Verification, Validation and Accreditation
WMD	Weapons of Mass Destruction



Military Operations Research Society (MORS)
Workshop

***Chemical-Biological Weapons of Mass Destruction:
Understanding the Problem***

30 January – 1 February 2001

TERMS OF REFERENCE

1.0 BACKGROUND

Understanding the comprehensive analysis problem of Chemical-Biological Weapons of Mass Destruction (CB WMD) threats to the United States is increasingly complex and difficult. The CB WMD threat continues to evolve and expand with the post-Cold War proliferation of CB technologies and weapon delivery systems. CB WMD is not just a military battlefield threat. There is a renewed interest in defending against CB WMD missile and terrorist threats to the United States homeland and worldwide U. S. facilities. CB WMD are now of growing concern not only to the Department of Defense; but, to U. S. law enforcement, emergency preparedness, and public health officials, too. Not only is it critical to effectively predict the effects of potential future attacks; but, it is essential to include post-analytic requirements, too.

The improved international availability of the technologies to develop weapons and delivery means, the continuing security vulnerabilities of an open American society, and the dynamic assortment of state and non-state adversaries promise to collectively bedevil the United States at home and abroad for the foreseeable future. This complex interconnected CB WMD threat warrants continued attention by the military operations research community in order to provide analytical support in conducting operations in actual and potential WMD environments, in contributing military support to civil authorities exercising CB WMD crisis and consequence management, in attaining military force protection abroad and at home, and in countering CB WMD proliferation and evolving threats. In addition to the growing CB WMD threat spectrum, the difficulties in understanding the CB WMD defense analysis problem are exacerbated by severe data limitations as a result of the ban on open air testing. For instance, recent analysis and limited laboratory testing have caused analysts to re-examine some of our historical operational and technical chemical effects data and modeling. This area is critical to our understanding of chemical weapons and demands further attention by the analytic community in order to revise or validate our analytical and operational understanding of the CB WMD defense problem.

CB WMD analysis should provide the underpinning for significant future improvements in protecting United States citizens, property, and interests. Analysis, simulation, and modeling is essential for characterizing CB WMD effects, evaluating U. S. Defense capabilities, defining requirements, conducting operational planning, supporting exercises and training, and for prioritizing acquisition programs. Whether in support of military operations or of civil authorities, a common set of significant CB WMD analysis factors include:

- characterization of CB WMD hazards, threat employment, and effects
- atmospheric transport and ground deposition of CB WMD agents and materiel
- real-time weather and wind forecasting
- detection, tracking, identification, and warning of CB WMD events
- health and psychological assessments and medical treatment
- post-attack spread, identification, and containment of contagious BW agents
- measures for mitigating CB WMD hazards and effects
- automated decision-support and communications systems that provide pre- and post-attack risk assessments of CB WMD hazards and options for mitigating CB WMD effects
- CB WMD consequence management and restoration of services/operations
- logistical support requirements
- post-attack assessments of predictive modeling effectiveness

There has been a rise in CB WMD-related organizations and in the analyses and studies within the Department of Defense (DOD) on the potential impacts of CB WMD as the Department's roles both in military operations spanning the spectrum from major theater war (MTW) to small-scale contingencies (SSC) and in civil support evolve. Major Defense participants responsible for sponsoring and funding aspects of Chemical-Biological WMD analysis include:

- The Deputy Assistant to the Secretary of Defense for Chemical & Biological Defense (DATSD(CBD)) remains the single office within OSD responsible for oversight of the DOD chemical and biological defense program.
- The Joint NBC Defense Board composed of the Joint Service Integration Group (JSIG) and the Joint Service Materiel Group (JSMG) is responsible for the planning, programming, budgeting, and executing functions for joint NBC defense.
- The Assistant to the Secretary of Defense for Civil Support (ATSD-CS) chairs DOD's WMD Preparedness Group as a means of coordinating DOD's consequence management activities and civilian agency response as well as providing civilian oversight for the development and implementation of planning guidance, policies, and procedures for the Joint Task Force for Civil Support (JTF-CS).
- The Joint Task Force for Civil Support is responsible for marshaling the capabilities of our Armed Forces in support of civilian agencies in response to domestic contingencies involving WMD. SECDEF charged the JTF-CS with undertaking detailed analyses, anticipating support requirements, and conducting exercises.
- The Under Secretary of Defense for Policy remains responsible, through the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict (ASD(SOLIC)), for crisis management, both domestic and abroad while simultaneously retaining responsibility for policy promulgation and preparedness for CB Consequence Management international support missions.
- The Defense Threat Reduction Agency (DTRA) provides CB defense support to the CINCs and other elements of the U. S. government. DTRA is a participant on the Office

of the Secretary of Defense's Nuclear, Biological, and Chemical (NBC) Defense Steering Committee and executes the joint NBC defense budgets.

The list of organizations participating and leading in the CB WMD arena is large and may be expanded. A sample cross-section of groups includes: the Consequence Management Program Integration Office (CoM-PIO), Joint Staff Strategic Deterrence Joint Warfighting Capability Assessment group, Department of Energy's CB Non-Proliferation Program, the Chemical, Biological, Radiological and Nuclear Countermeasures Sub-Group of the Technical Support Working Group, Center for Disease Control, National Institutes of Health, Public Health Service, Dugway Proving Grounds, and U. S. Army Center for Health Promotion and Preventive Medicine. Additionally, each Service is responsible for the training and equipping of its forces for defense against CB WMD. Many of these actions are coordinated among the Services through the JSIG and JSMG. The CINCs implement WMD defense measures through OPLANs and other efforts.

2.0 GOAL, OBJECTIVES, AND SCOPE

2.1 Goal

The goal of this workshop is to develop a comprehensive and improved understanding of the Chemical-Biological WMD analysis problem confronting the United States at home and abroad and to assess the military operations research community's capabilities to support military and civil CB WMD defense, crisis response, and consequence management efforts. Since the military CB WMD analysis problem is closely intertwined with civil support, analysts from the federal departments are to be invited. Although the primary goal is to support the military analytical community, participation by CB WMD analysts from the federal departments will provide opportunities for mutual enrichment through the sharing of analytical approaches, data, and tools.

2.2 Objectives

In order to achieve a better understanding of the CB WMD defense analysis problem, the workshop will identify and evaluate the following objectives:

- Characterization of CB WMD threats and effects by OR techniques
- Military operations research capabilities to support military and civil authorities
- Current and anticipated CB WMD analytical tools, methodologies, and shortfalls
- CB WMD data sources, data shortfalls, test results, and study efforts

2.3 Scope

The scope is confined to operations research capabilities and shortfalls for the defense against potential adversaries' employment of CB WMD in military operations spanning the spectrum from major theater warfare to small scale combat to counterterrorism to homeland security. The discussions are to focus upon analytic support for the following topics related to both military operations and military support to civil authorities:

- Operations Analysis
- Training Simulations and Models
- Simulation-based Acquisition

2.4 Issues

Within the context of the goals and objectives outlined above, the workshop is designed to consider the following issues in better understanding the CB WMD problem:

- How well do CB WMD modeling, simulation, and analysis support the operational capabilities of U. S. and coalition military forces (contamination avoidance, protection, force sustainment)?
- How well do CB WMD modeling, simulation, and analysis support civil defense preparedness?
- What are the credibility, reliability and usefulness in analysis of historical CB test data? How can the OR community improve data acquisition capabilities in order to both improve current and develop new CB WMD defense models?
- What are the current CB WMD analytical efforts and priorities of effort? Does the OR community provide timely support at a reasonable cost? How can analysts anticipate requirements in order to initiate timely model development?
- What CB WMD model enhancements demonstrate improved analytic results and resulting support to the warfighter/field operator and other users?
- How is CB WMD depicted in general combat simulations?
- How can analysis best support WMD defense policymaking?
- What are the analytical differences and similarities between supporting military operations and military support to civil authorities and how can successful analytical approaches in one set of operations be leveraged for success in the other set of operations?
- What are the data gaps and how can analysts provide credible support with varying degrees of uncertainty in CB weapons functioning and effects?

3.0 APPROACH

3.1 Overview

The approach consists of a three-day workshop. On the first day, all participants will convene in a plenary session for a broad, strategic discussion of the CB WMD analysis problem confronting the United States defensively both at home and abroad. Speakers and panels will serve to introduce key issues, to challenge participants, and to set the groundwork for a deeper discussion during the remainder of the workshop. A keynote speaker of national military renown is tentatively planned to open the workshop and will be charged both with defining the CB WMD defense analysis requirements from a CINC's perspective and with challenging the audience. Following the keynote speaker, the first day will be divided between speakers and panels to address separately military CB WMD operations and military support to civil authorities for CB WMD defense and consequence management. The first group of speakers is tentatively planned to include the DATSD(CBD) followed by a panel of 4 distinguished speakers from the JSIG, DTRA, Counter-proliferation Joint Warfighting Capabilities Analysis (CP JWCA) team, and

RAND to describe warfighting CINC requirements that warrant attention by the military operations research community. The second and last group of speakers is tentatively planned to include the ATSD-CS followed by a panel of 4 distinguished speakers from the JSMG, Army Medical Research/Center for Disease Control, JTF-CS, and the Federal Emergency Management Agency (FEMA). Collectively, these speakers will be charged with directing the audience to focus upon analytical concerns in deterring, defeating, and mitigating the effects of CB WMD attacks against our military, civilians, and national infrastructure.

The remainder of the workshop is designed to address and to integrate operations research practitioners and field operators for both military operations and military support to civil authorities under actual and potential WMD conditions. The second day of the workshop is set aside for working groups to discuss military operations ranging from major theater warfare to small scale contingencies. The third day of the workshop is designed for the same working groups to examine military support to civil authorities. These critical examinations of both types of operations by the same working groups serve to compare, contrast, and leverage operations research capabilities across both venues. The workshop will conclude in plenary session on the afternoon of the last day with presentations summarizing the working groups' discussion, findings, and recommendations.

3.2 Working Groups

The workshop is organized into four working groups:

- Operations Analysis
- Training Simulations and Models
- Simulation-based Acquisition
- Synthesis

As noted earlier, each of the first three working groups will address analysis for both combat and civil support operations. Co-chairs, one from each community, will be appointed – combat operations and military support to civil authorities. Additionally, these working groups will likely be sub-divided into smaller sub-working groups in order to allow focused discussion in key areas. Sub-working groups remain to be defined by working group chairs who are to be identified.

The fourth working group, the Synthesis Working Group, composed of a small group of individuals selected by the Co-Chairmen and Organizing Committee is designed to operate independently in order to provide the Co-Chairmen with an independent and impartial assessment of the working groups' discussion, findings, and recommendations.

3.2.1 Operations Analysis

The Operations Analysis Working Group (OAWG) is tasked to address and investigate analysis issues ranging from major theater warfare to small-scale combat, counterterrorism, & homeland security.

3.2.2 Training Simulations and Models

The Training Simulations and Models Working Group (TSMWG) is tasked to address the opportunities that operations research products provide for training. These may span the gamut from distributed interactive simulations to computer-based learning and include operations models.

3.2.3 Simulation-based Acquisition

The Simulation-based Acquisition Working Group (SBAWG) is tasked to address analysis issues related to materiel research, development, and acquisition for military forces, federal and state preparedness elements, and coalition/host nation allies.

3.2.4 Synthesis

The Synthesis Working Group (SWG) is tasked to provide the Co-Chairmen with an independent and impartial assessment of the working groups' discussion, findings, and recommendations.

3.3 Working Group Approach

Each working group co-chair will coordinate an introductory presentation summarizing the state of the art in analysis for their respective groups. Additionally, depending upon attendance and interest of the invitees, co-chairs may sub-divide working groups to address more specific areas of interest. Working group co-chairs are responsible for identifying sub-working group chairs.

These sub-working group chairs will follow the same discussion format outlined directly above. Working group co-chairs are to be identified by Nov 1 and sub-working group chairs by Dec 1.

All chairs are tasked with preparing an after action report briefing for presentation on the last afternoon of the workshop.

4.0 PRODUCTS

4.1 Reports and Briefings

- Executive Summary and After-Action Briefing to Sponsors (S: 1 Mar '01)
- Final Report to MORS Office (S: 1 May '01)
- 69th MORSS Briefing (S: 12 Jun '01)

4.2 News Articles

- *PHALANX* article announcing CB WMD Workshop (S: 5 Oct '00; submitted)
- *PHALANX* article summarizing CB WMD Workshop (S: 15 Feb '01)

5.0 ADMINISTRATION

5.1 Dates: Workshop: 30 Jan – 1 Feb '01

5.2 Location: Booz Allen & Hamilton (BAH), McLean, VA

5.3 Classification: SECRET

5.4 Proponents: DATSD(CBD)

5.5 Registration Fees:

\$200 U.S. Federal Government Employees
\$400 Others

5.6 Tentative Agenda

DAY 1

Registration

Call to Order

 Program Chair (includes Security Briefing)
 MORS President

Overview

Keynote Presentation

DATSD(CBD) Presentation

1st Panel: Four Presentations followed by Q&A

Luncheon

ATSD-CS Presentation

2nd Panel: Four Presentations followed by Q&A

Mixer

DAY 2

Registration

Morning Working Group/Sub-Working Group Sessions

Luncheon (groups may elect to have working luncheons)

Afternoon Working Group/Sub-Working Group Sessions

Chairmen's Hot Wash

DAY 3

Registration

Morning Working Group/Sub-Working Group Sessions

Luncheon (groups may elect to have working luncheons)

Plenary Session: Working Group/Synthesis Working Group After-Action Reports

Chairmen's Hot Wash

